U.S. Department of Transportation
Federal Aviation Administration

Subject:	POLICY: Low and High Speed Awareness Cues for Linear Tape Airspeed Displays	Date:	SEP 11, 1996
From:	Manager, Transport Airplane Directorate, ANM-100	Reply to Attn. of:	
To:	See DISTRIBUTION		

References:

1. Advisory Circular 25-11, "Transport Category Airplane Electronic Display Systems," July 16, 1987.

2. ANM-100 Policy Memorandum, "Airspeed Displays for Electronic Flight Instrument Systems (EFIS)," February 25, 1992.

Paragraph 7d(2)(i) of Advisory Circular (AC) 25-11 (Reference 1) notes the difficulty that exists for linear tape displays to provide the type of quick-glance sense of airspeed (or altitude) that is inherently available with round-dial moving pointer displays. Many applicants have implemented color-coded bands in their electronic airspeed displays to provide this same type of quick-glance awareness of the proximity to an unsafe operating speed. The Reference 2 policy memorandum provided guidance relative to the importance of considering all the pertinent independent parameters that may affect the speed against which protection is being provided. This memorandum provides more specific information on this subject as related to low and high speed awareness cues. Low speed awareness cues should provide adequate warning to the pilot that the airspeed is below the reference operating speed for the airplane configuration (i.e., weight, flap setting, landing gear position, etc.); similarly, high speed awareness cues should provide adequate warning to the pilot that the airspeed is approaching an established upper limit that may result in a hazardous operating condition.

Section 25.1541(b)(2) of the Federal Aviation Regulations states: "The airplane must contain - Any additional information, ***instrument markings***, and placards required for the safe operation if there are unusual design, operating, or handling characteristics." The Part 25 regulations related to instrument systems and their markings were not developed with modern day EFIS displays in mind; consequently, these EFIS displays are considered an "unusual design characteristic," per § 25.1541(b)(2), that may require additional markings to warrant safe operation. In particular, it is considered necessary to incorporate additional markings on electronic airspeed displays, in the form of low and high speed awareness cues, to provide pilots the same type of "quick glance" airspeed awareness that was an intrinsic feature of round dial instruments.

AC 25-11 provides information related to EFIS markings in terms of design and standardization. Paragraph 5a(3)(i) of AC 25-11 relates a list of acceptable display colors to their functional meaning; that list recommends "red" for warnings and limit conditions, and "amber/yellow" for cautions and abnormal conditions. A survey of FAA-approved EFIS installations revealed this color usage has become essentially an industry standard.

Low speed awareness cues should be provided as color-coded bands on EFIS linear tape airspeed displays; in accordance with AC 25-11, the preferred colors to be used are amber/yellow to indicate the airspeed has decayed below a reference speed that provides adequate maneuver margin, changing to red at the stall warning speed. The speeds at which the low speed awareness bands start should be chosen as appropriate to the airplane configuration and operational flight regime. For example, low speed awareness cues for approach and landing should be shown starting at V_{REF} with a tolerance of +0 and -5 knots. Some FAA approved systems use a pilot selectable operating speed "bug" at V_{REF} supplemented by system-computed low speed cues that vary in color as airspeed decreases below certain multiples of the appropriate stall speed (e.g., white below $1.3V_S$, amber below $1.2V_S$, and red below $1.1V_S$) The specific operating needs of other flight regimes should be considered in developing the criteria for the visual cue that will be provided.

Low speed awareness displays should be sensitive to load factor (g-sensitive) to enable the pilot to maintain adequate maneuver margins above stall warning in all phases of flight. The accuracy of this g-sensitivity function should be verified by flight tests. Flight tests should also be conducted in maneuvering flight and expected levels of turbulence to evaluate proper functioning of any damping routines incorporated into the low speed awareness software; the level of damping should preclude nuisance/erratic movement of the low speed cues during operation in turbulence but not be so high that it inhibits adequate response to accurately reflect changes in margins to stall warning and stall during maneuvering flight.

High speed awareness should be provided to prevent inadvertent excursions beyond limit speeds. Symbology should be provided to permit easy identification of flap and landing gear limit speeds. A visual cue should be incorporated to provide adequate awareness of proximity to V_{MO} ; this awareness has been provided by amber bands, similar to the previously discussed low speed cues, and instantaneous airspeed displays that turn amber (or flash amber digits) as the closure rate to V_{MO} increases beyond a value that will provide adequate time for pilot corrective action to be taken without exceeding the limit speed.

As noted in paragraph 5a(4) of AC 25-11, deviations from the recommended color assignments may be found acceptable if they are not susceptible to confusion or color meaning transference problems. Cross-hatching may be acceptable to provide a delineation between amber and red zones, or between zones of different meaning as in the case of a monochromatic display such as a heads-up guidance system display.

Any proposed deviation from the guidelines presented in this memorandum should be coordinated with the technical specialists at the Transport Standards Staff, ANM-110, in Renton, Washington.

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